PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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08/638,961 24 April 1996 (24.04.96) US

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(63) Related by Continuation
US 08/638,961 (CIP)
Filed on 24 April 1996 (24.04.96)

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(72) Inventors; and
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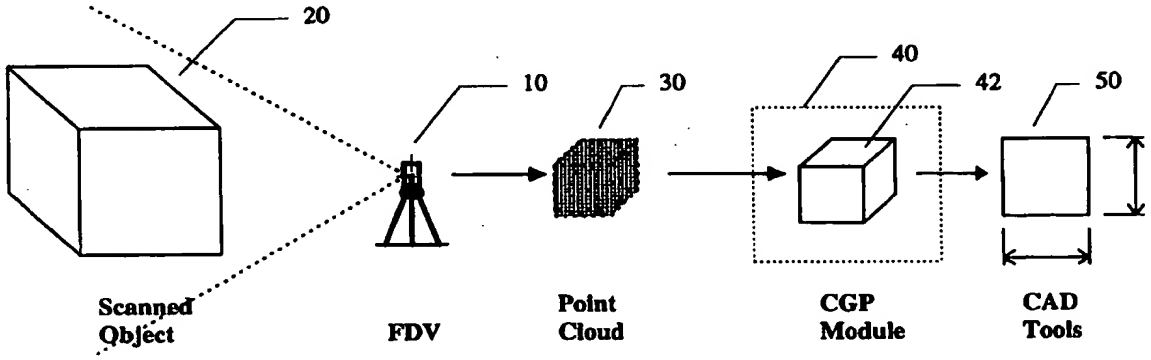
(81) Designated States: CA, JP, US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(88) Date of publication of the international search report:
30 July 1998 (30.07.98)

(54) Title: INTEGRATED SYSTEM FOR IMAGING AND MODELING THREE-DIMENSIONAL OBJECTS



(57) Abstract

An integrated system generates a model of a three-dimensional object. A scanning laser device scans the three-dimensional object and generates a point cloud. The points of the point cloud each indicate a location of a corresponding point on a surface of the object. A first model is generated, responsive to the point cloud, that generates a first model representing constituent geometric shapes of the object. A data file is generated, responsive to the first model, that can be inputted to a computer-aided design system.

INTERNATIONAL SEARCH REPORT

Inte...ational Application No
PCT/US 97/06793

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G01C11/00 G01B11/24 H01S3/131 G02B26/12 G06T5/00
G06K9/00 G01S7/484 G01S7/497 G06T5/50 G01S17/89

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G01C G01B H01S G02B G06T G06K G01S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	BRADLEY C ET AL: "FREE-FORM SURFACE RECONSTRUCTION FOR MACHINE VISION RAPID PROTOTYPING" OPTICAL ENGINEERING, vol. 32, no. 9, 1 September 1993, pages 2191-2200, XP000396836 see the whole document ---	1-3
X	GB 2 292 605 A (FOWLER ET AL.) 28 February 1996 see the whole document ---	1-3
A	US 4 658 218 A (G.A. KENNEY-WALLACE) 14 April 1987 see column 2, line 7 - line 50 ---	4
	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 May 1998	03.06.98

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Devine, J

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inte...ational Application No
PCT/US 97/06793

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	NARAYAN SRIRANGA RAJA ET AL.: "Obtaining generic parts from range images using a multi-view representation" IMAGE UNDERSTANDING, vol. 60, no. 1, July 1994, ORLANDO, FL, US, pages 44-64, XP000456566 see abstract see page 58; figure 30 ---	6-17
A	US 4 907 586 A (JOSEF F. BILLE ET AL.) 13 March 1990 see column 4, line 46 - column 7, line 55 ---	18
Y	PATENT ABSTRACTS OF JAPAN vol. 006, no. 062 (P-111), 21 April 1982 & JP 57 004564 A (HITACHI LTD), 11 January 1982, see abstract ---	19-21
Y	PATENT ABSTRACTS OF JAPAN vol. 011, no. 324 (P-628), 22 October 1987 & JP 62 108172 A (FUJI ELECTRIC CO LTD), 19 May 1987, see abstract ---	19-21
A	DE 41 09 844 C (ELTRO GMBH) 11 June 1992 see the whole document ---	19-22
X	SHINICHI TAMURA ET AL.: "Error correction in laser scanner three-dimensional measurement by two-axis model and coarse-fine parameter search" PATTERN RECOGNITION, vol. 27, no. 3, March 1994, HEAD.HILL, OXFORD, GB, pages 331-338, XP000440586 see table 2 on page 335	23
Y		24
A		27,28
Y	TAKEO KANADE ET AL.: "A very fast VLSI rangefinder" PROCEEDINGS OF THE 1991 IEEE INTERNATIONAL CONFERENCE ON ROBOTICS AND AUTOMATION, April 1991, SACRAMENTO, CALIFORNIA, US, pages 1322-1329, XP000221223 see page 1329, right-hand column, paragraph 2	24
A	--- -/--	26

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 97/06793

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see continuation sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 97/06793

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2292605 A	28-02-96	AU 3263695 A	14-03-96
		CA 2198124 A	29-02-96
		EP 0805948 A	12-11-97
		WO 9606325 A	29-02-96
US 4658218 A	14-04-87	NONE	
US 5531520 A	02-07-96	CA 2198492 A	07-03-96
		EP 0778967 A	18-06-97
		JP 9511430 T	18-11-97
		WO 9607144 A	07-03-96
US 4907586 A	13-03-90	NONE	
DE 4109844 C	11-06-92	NONE	

PATENT COOPERATION TREATY

EXPRESS MAIL LABEL NO. EM461821941US
Atty Docket No. KYRA-410 US4

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT LIMBACH & LIMBACH

To:
STALLMAN, Michael A.
LIMBACH & LIMBACH L.L.P.
2001 Ferry Building
SAN FRANCISCO, CALIFORNIA 94111-4262
ETATS-UNIS D'AMERIQUE

NOTIFICATION OF RECEIPT OF DEMAND

(PCT Rule 61.1(b), first sentence and Administrative Instructions, Section 601)

Date of mailing *(day/month/year)*	20. 11. 97
Applicant's or agent's file reference: KYRA-410 PCT	IMPORTANT NOTIFICATION

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 97/06793	24/04/1997	24/04/1996

Applicant: CYRA TECHNOLOGIES, INC. et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority considers the following date as the date of receipt of the demand for international preliminary examination of the international application:

10/11/1997

2. This date of receipt is:

☒ the actual date of receipt of the demand.

☐ the date on which the proper corrections to the demand were timely received.

3. ☐ This date is **AFTER** the expiration of 19 months from the priority date.

Attention: The election(s) made in the demand does (do) not have the effect of postponing the commencement of the national phase until 30 months from the priority date (or later in some Offices)(Article 39(1)). Therefore, the acts for entry into the national phase must be performed within 20 months from the priority date (or later in some Offices) (Article 22).

For details, see Annex B to Form PCT/IB/301 sent by the International Bureau and Volume II of the PCT Applicant's Guide.

☐ This notification confirms the information given in person or by telephone on:

4. Only where paragraph 3 applies, a copy of this notification has been sent to the International Bureau.

Name and mailing address of the IPEA/	Authorized officer	Helga Eckert
European Patent Office D-80298 Munich Tel. (+49-89) 2399-0, Tx: 523656 epmu d Fax: (+49-89) 2399-4465		-24 07
	Telephone No.	

EXPRESS MAIL LABEL NO.
EM461821941US
Atty Docket No. KYRA-410 US4

PATENT COOPERATION TREATY

IN THE EUROPEAN PATENT OFFICE
INTERNATIONAL SEARCHING AUTHORITY

In re Int'l Application of CYRA TECHNOLOGIES, INC. et al.	Authorized Officer: Falk Heck
International Application No. PCT/US97/06793	RESPONSE TO INVITATION TO PAY ADDITIONAL FEES (PCT ARTICLE 17(3)(a) AND RULE 40.1)
International Filing Date: 24 April 1997 (24.04.97)	
For: **INTEGRATED SYSTEM FOR QUICKLY AND ACCURATELY IMAGING AND MODELING THREE DIMENSIONAL OBJECTS**	

European Patent Office
P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk
NETHERLANDS

ATTENTION: ISA/EPO

Dear Sirs:

In response to the Invitation to Pay Additional Fees pursuant to PCT Article 17(3)(a) and Rule 40.1 dated September 19, 1997, Applicants hereby submit a Bank Draft in the amount of Deutsche Mark 15,400.00 for searching the seven additional inventions contained in the above-identified International Application.

Respectfully submitted,

LIMBACH & LIMBACH L.L.P.

Dated: Oct. 10, 1997

By 

Michael A. Stallman
Registration No. 29,444
2001 Ferry Building
San Francisco, CA 94111
(415) 433-4150
Attorneys for Applicants

(KYRA-410 PCT)

EXPRESS MAIL LABEL NO.
EM461821941US
Atty Docket No. KYRA-410 US4

PCT/US97/06793 PATENT

INTERNATIONAL APPLICATION UNDER THE
PATENT COOPERATION TREATY
EUROPEAN PATENT OFFICE AS
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

International Application of: Cyra Technologies, Inc. et al.	Examining Officer C. Kunzelmann
Int'l Application No. PCT/US97/06793	TRANSMITTAL LETTER
Int'l Filing Date: 24 April 1997 (24.4.97)	2001 Ferry Building San Francisco, CA 94111 U.S.A. (415) 433-4150
For: INTEGRATED SYSTEM FOR QUICKLY AND ACCURATELY IMAGING AND MODELING THREE-DIMENSIONAL OBJECTS	

VIA FACSIMILE - CONFIRMATION VIA DHL COURIER

European Patent Office as
International Preliminary Examining Authority
Erhardstrasse 27
D-80298 München
GERMANY

Sir:

Applicant, through its undersigned attorneys, submits its Response to Invitation to Restrict or to Pay Additional Fees Issued 14 July 1998 (14.7.98), together with an attachment of proposed new claims.

Respectfully submitted,
LIMBACH & LIMBACH L.L.P.

Dated: Aug 7, 1998

By: _____

Michael A. Stallman
2001 Ferry Bldg.
San Francisco, CA 94111
U.S.A.
(415) 433-4150

Attorneys for Applicant(s)

INTERNATIONAL APPLICATION UNDER THE
PATENT COOPERATION TREATY
EUROPEAN PATENT OFFICE AS
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

International Application of: Cyra Technologies, Inc. et al.	Examining Officer C. Kunzelmann
Int'l Application No. PCT/US97/06793	RESPONSE TO INVITATION TO RESTRICT OR TO PAY ADDITIONAL FEES ISSUED
Int'l Filing Date: 24 April 1997 (24.4.97)	14 JULY 1998 (14.7.98)
For: INTEGRATED SYSTEM FOR QUICKLY AND ACCURATELY IMAGING AND MODELING THREE-DIMENSIONAL OBJECTS	2001 Ferry Building San Francisco, CA 94111 U.S.A. (415) 433-4150

VIA FACSIMILE - CONFIRMATION VIA DHL COURIER

European Patent Office as
International Preliminary Examining Authority
Erhardstrasse 27
D-80298 München
GERMANY

Sir:

In response to the Invitation to Restrict or to Pay Additional Fees issued 14 July 1998, Applicants respond as follows:

Applicant wishes to restrict the claims for examination to the subject matter of original claims 1 through 3 relating to an integrated system. In response to the Examiner's rejection, Applicant has drafted additional claims directed to an integrated system of a much more narrow scope. Because of the length of the application and complexity involved in renumbering the claims, Applicant has attached the new claims as a proposal, rather than using the Substitute Sheets format. Applicant respectfully requests that the Examiner

consider the claims in this form in order to save time and costs.

The new claims 37 to 51 are directed to a system which can scan and sense the position in three-dimensional space of points on a surface of an object and then generate a computer model or image of that object with internal software. The system is further capable of transforming that model into a data file compatible with various computer aided programs. Thus, the subject invention is capable of both gathering the data and reducing the data to a form which can be easily manipulated by the user.

As defined by the new claims, the subject invention further relates to the interplay between the scanning system, the modeling module, and the user interface. More specifically, a user driven system controls the interaction between the laser scanner and the modeling software. The system allows the user to define in real time, which regions of the object should be scanned, and the level of resolution at which those regions should be scanned. In a typical operation in the field, a user might scan the entire visible surface of the object at a low level of resolution. Certain regions within the sample that have more complex features would require much higher resolution for proper modeling. The system allows the user to easily target those areas which require additional scanning at higher resolution. In addition, the system seamlessly integrates the additional data derived from successive scans into the model.

As shown in the Figures, the user interface includes a split screen. The right-hand portion of the screen illustrates features of the model which are generated by the software based on the scanned

data points. This screen is continuously updated following each scan. The left-hand portion of the user interface includes a video image of the object. This video image of the object is used to target the regions to be scanned. This targeting window permits the user to identify the area of interest with various pull-down menus and stretch bounding boxes. As can be appreciated, the user can view the modeling of the scanned image in the right-hand image to determine which regions of the object require higher resolution scanning. Based on the information, the targeting window can be utilized to highlight those regions which require additional higher resolution scans. The user can indicate the density, or resolution of the scanning operation by defining either the number of samples in each direction, or the angular separation between adjacent samples. This aspect of the subject invention is more clearly defined in the newly submitted claims which are believed to distinguish over the prior art cited by the Examiner.

Respectfully submitted,
LIMBACH & LIMBACH L.L.P.

Dated: 8/7/98
Aug 7

By: _____

Michael A. Stallman
2001 Ferry Bldg.
San Francisco, CA 94111
U.S.A.
(415) 433-4150
Attorneys for Applicant(s)

Atty Docket No. KYRA-410 PCT

NEW PROPOSED CLAIMS

37. An apparatus for imaging and modeling three dimensional objects comprising:

an imaging module for emitting a laser beam for scanning the surface of a remote object and recording data points corresponding to the points on the surface of the object;

a modeling module for converting the data points into a three dimensional image of the object;

a user interface for inputting commands, said commands including an identification of a region of the surface of the object and specifications for the level of resolution desired for that region; and

a processor for controlling the operation of the imaging module, the modeling module and the user interface and being arranged to generate an overall scan of the object and a scan of the selected region within the object and wherein said modeling module functions to integrate data points from the scans into a composite image.

38. An apparatus as recited in claim 37 wherein said scan of the region has a resolution different from the scan of the overall object.

39. An apparatus as recited in claim 38 wherein said scan of the region has a higher resolution than the scan of the object.

40. An apparatus as recited in claim 37 further including a camera for obtaining a video image of the object and wherein said user interface includes a

display for displaying the video image of the object and wherein the user can identify the region of the object to be scanned from the video image.

41. An apparatus as recited in claim 40 wherein said three dimensional image generated by said modeling module is also displayed on said display.

42. An apparatus as recited in claim 37 wherein the three dimensional image generated by said modeling module includes geometric shapes corresponding to portions of the remote object.

43. A method of imaging and modeling three dimensional objects comprising the steps of:

a) scanning the surface of a remote object with a laser beam and recording data points corresponding to points on the surface of the object;

b) modeling the data points into a three dimensional image of the object;

c) scanning a region of the surface of the remote object and recording additional data points corresponding to points on the surface of the object within that region; and

d) integrating the data points from the scans into the three dimensional image.

44. A method as recited in claim 43 wherein the scanning of the region of the object performed in step c is performed at a higher resolution than the scan performed in step a.

45. A method as recited in claim 43 wherein the scanning of step a is performed before the scanning of the region in step c.

46. A method as recited in claim 43 wherein the three dimensional image generated during said modeling step includes geometric shapes corresponding to portions of the remote object.

47. A method as recited in claim 43 further including the steps of:

e) capturing a video image of the object; and

f) displaying the video image and wherein the region to be scanned in step c is selected by the user utilizing the video image of the object as a reference.

48. A method as recited in claim 47 wherein the region selected for scanning in step e includes a portion of the object corresponding to a geometric shape and wherein the additional data points are used to refine the geometric shape during step d.

49. A method as recited in claim 47 wherein the user indicates the density of the scanning operation by defining the number of samples to be taken in the region.

50. A method as recited in claim 47 wherein the user indicates the density of the scanning operation by defining the angular separation between adjacent data points.

51. A method as recited in claim 47 further including the step of generating a data file from the three dimensional image which can be inputted into a computer-aided design system.

PATENT COOPERATION TREA..

From the
INTERNATIONAL PRELIMINARY EXAMINATION AUTHORITY

To:

STALLMAN, Michael A.
LIMBACH & LIMBACH L.L.P.
2001 Ferry Building
SAN FRANCISCO,CALIFORNIA 94111-4262
ETATS-UNIS D'AMERIQUE

PCT

INVITATION TO RESTRICT OR TO PAY ADDITIONAL FEES

(PCT Article 34(3) (a) and Rule 68.2)

Date of mailing (Day/month/year)	07.98
Applicant's or agent's file reference: KYRA-410 PCT	REPLY OR PAYMENT DUE: within 1 month(s) from the above date of mailing

International application No.	International filing date (day/month/year)	Priority date (day/month/year)
PCT/US97/06793	24/04/1997	24/04/1996

International Patent classification (IPC) or national Patent classification:
G01C11/00

Applicant
CYRA TECHNOLOGIES, INC. et al.

1. This International Examining Authority

   (i) considers that the international application does not comply with the requirements of unity of invention (Rule 13.1, 13.2 and 13.3) for the reasons indicated in the Annex.

   (ii) therefore considers that there are 8 inventions claimed in the international application as indicated in the Annex.

   (iii) recalls that claims relating to inventions in respect of which no international search report has been established need not be the subject of international preliminary examination (Rule 66.1 (e)).

2. Consequently the applicant is hereby invited, within the time limit indicated above, to restrict the claims as suggested under item 3, below, or to pay the amount indicated below:

   3000 DM. (Fee per additional invention) x 7 (number of additional inventions) = 21000 DM (total amount of additional fees) 12,010

   The applicant is informed that, according to Rule 68.3 (c), the payment of any additional fee may be made under protest, i.e. a reasoned statement to the effect that the international application complies with the requirement of unity of invention or that the amount of the required additional fee is excessive.

3. If the applicant opts to restrict the claims, this Authority suggests the restriction possibilities indicated in the Annex, which in its opinion would be in compliance with the requirement of unity of invention.

4. In the absence of any response from the applicant, this Authority will establish the international preliminary examination report on those parts of the international application indicated in the Annex which, in the opinion of this Authority appear to relate to the main invention.

Name and mailing adress of the international preliminary examination authority:	Authorized officer
European Patent Office D-80298 Munich Tel. (+49-89) 2399-0, Tx: 523656 epmu d Fax: (+49-89) 2399-4465	Kunzelmann, C Telephone No. (+49-89) 2399-2834

Form PCT/IPEA/405 (July 1992)

INVITATION TO RESTRICT OR TO PAY ADDITIONAL FEES International application No. PCT/US97/06793

As will be set out below, this international application is at least eightfold non-unitary. The eight inventions are set out in claims 1 - 3; 4; 5; 6 - 17; 18; 19 -22, 35, 36; 23 - 27; 28 - 34. Hence, this invitation is structured essentially according to these eight inventions.

1.1. Reference is made to the following documents:

D1 = COLIN BRADLEY ET AI:
"FREE-FORM SURFACE RECONSTRUCTION FOR MACHINE VISION RAPID PROTOTYPING";
OPTICAL ENGINEERING, vol. 32, no. 9, 1 Septembe: 1993, pages 2191 - 2200.

D2 = GB-A-2 292 605

2) **NOVELTY (Article 33(2) PCT):**

2.1. Document D1 is considered to represent the nearest prior art as far as **claims 1 - 3** are concerned. This document describes a system for prototyping, ie for generating a model of a three-dimensional scene (see the paragraph "Introduction"). The prototyping system is a 3-D laser scanner system integrated with a CNC machining center and a programmable CMM (see the paragraph "Interfacing the Range Sensor with a Translation System"). The laser scanner produces a point cloud ("cloud data") of points, each point corresponding to a location on the surface of the scanned scene. In the paragraph "Reconstructing Free-Form Surfaces", various techniques for generating a three-dimensional model from the point cloud are described. The mathematical model is used to physically machine the surface a body so that the desired model is established (see the Section "Testing of the free-Form Surface Modelling Method").

Hence, document D1 shows an integrated system according to claim 1. Therefore, the claimed system is not novel (Article 33(2) PCT).

Furthermore, the input of the data file corresponding to the scanned model into a CAD system is also described in the Sections "Introduction" and "Testing of the free-Form Surface Modelling Method". Clearly, the CAD system must be started

somehow, and the loading of the data file must be performed automatically (by the software governing the loading process). Hence, the system of claims 2 and 3 is not novel, either.

For the sake of completeness, it is mentioned that document D2 is similarly relevant (see claim 1 in combination with page 4, line 6 - page 5, line 12 and page 8, line 34 - page 9, line 3). The relation with the CAD system is mentioned on page 22.

2.3. The apparatus of **claims 28 - 33** is known from document D12 (see paragraph 8.1. below), since this document (see the paragraph 1. Introduction) mentions the combination of a laser beam scanning the object and of taking a TV camera image of the object for calibration purposes (see paragraph 4. calibration).

3) **INVENTIVE STEP (Article 33(3) PCT):**

3.1. Reference is made to the following document:

D3 = US-A-4 658 218
D4 = JP-A-06 188 501 (English abstract)

3.2. Document D3 is considered to represent the nearest prior art as far as **claim 4** is concerned.
This document describes a laser system in which a dye laser's 16 output pulse is fed into an optical amplifier chain 18. The amplifier chain is pulsed by a Nd:YAG laser; the Nd:YAG pulse timing is determined by an active Q-switch.

It is common knowledge in the art of lasers that there are two fundamental possibilities for controlling the timing of laser output pulses. The first one is to bring the laser in a condition where it is ready for lasing, and then to use an active Q-switch to release the laser pulse at a predetermined time. The second one is to pump the laser until it reaches the lasing threshold, and allowing lasing as soon as the threshold is reached (no Q-switch or passive Q-switch). Documents D3 and D4 describe the first possibility.

Present claim 4 would appear to claim the second one of these two known fundamental possibilities.

Hence, the method of claim 4 does not involve an inventive step (Article 33(3) PCT), because it results from the application of the second fundamental possibility mentioned above to the known problem of controlling the timing of laser pulses in scanning lasers.

4) Present claim 5 would appear to cover any mouse-supported image processing software: It is well-known that image processing software allows to select regions of interest (ie to select all the data points representing a desired feature), starting from the complete data set, ie from all the available image points, including all the point sets which cover a desired feature. This is frequently done using a computer mouse by marking the borders of the regions of interest (ie drawing a polygonal lasso). This step can be repeated as often as necessary and also for a plurality of views of the respective region.

Hence, it would appear that claim 5 is the obvious application of well-known image processing software to images in the form of clouds of points representing three-dimensional features in a scene. Thus, the method of claim 5 does not appear to involve an inventive step.

5.1. Reference is made to the following documents:

D5 = JONG HOON PARK ET AL.:
"Three-dimensional object representation and recognition based on surface normal images", PATTERN RECOGNITION, vol. 26, no. 6, June 1993, pages 913 - 921

D6 = PAUL A. HEMLER ET AL.:
"Active model matching in range images"
IEEE INTERNATIONAL CONFERENCE ON ROBOTICS AND AUTOMATION, vol. 1, 31 March 1987 - 3 April 1987, RALEIGH, NC US, pages 228 - 233

INVITATION TO RESTRICT OR TO PAY ADDITIONAL FEES International application No. PCT/US97/06793

D7 = NARAYAN SRIRANGA RAJ ET AL.:
"Obtaining generic parts from range images using a multi-view representation",
IMAGE UNDERSTANDING, vol. 60, no 1. July 1994, ORLANDO, FL, US
pages 44 - 64

5.2. **Claims 9 - 17** relate to different methods for fitting or modelling a point cloud to a three-dimensional object. There is extensive literature about these modelling problems (see documents D5 - D7). In particular, it would appear that the three-dimensional bodies mentioned in claims 9 - 13 (cube, sphere, cylinder) are among the normal part primitives which are on the basis of any object modelling or object matching (see document D9, section I. Introduction). Similarly, the fitting techniques mentioned in these claims appear to be usual ones.
The merging of two or more geometric primitives to form a single geometric primitive (claim 14) would appear to be known from the object-matching of complicated multi-part objects (see document D9, section 5. Obtaining parts-based representation). The coordinates system transformation of claim 15 would appear to be known from document D5 (Section 1. Introduction).
Hence, the subject-matter of these claims does not appear to involve an inventive step.

6.1. Reference is made to the following document:

D8 = US-A-4 907 586

6.2. The system of **claim 18** differs from the known systems according to documents D1 or D2 in that a particular type of laser is used. However, this particular type of laser is known for instance from document D8 (see col. 4, line 46 - col. 5, line 20). Even though the particular intended use of the laser of document D8 is different from the one of documents D1 and D2, it would appear to be within the customary practice of the person skilled in the art to consider any known laser which would be an alternative to the ones of documents D1 or D2. In particular, it would appear that pulsed lasers could have advantages over cw lasers when using the laser beam for scanning a three-dimensional object for forming the respective point cloud, because disadvantages related to the movement of the laser beam across the object may be reduced.

Hence, it would appear that the person skilled in the art would have had good reasons to consider in particular the pulsed laser of document D8 for the use according to documents D1 or D2.
Thus, the system of claim 18 does not appear to involve an inventive step.

7.1. Reference is made to the following documents:

D9 = JP-A-62 108 172
D10 = JP-A-57 004 564
D11= DE-A-41 09 844

7.2. Document D9 is considered to represent the nearest prior art as far as claims 19 - 22 are concerned. From this document, the calibration of laser range finders using an optical fibre of known length is known. The calibration takes place by sending a light pulse through an optical fibre of known length and coupling the returning pulse into the detector of the laser range finder. The "offset error" mentioned in document D9 is an error which is relevant in the calibration of the measuring electronics. That the offset error is related to a delay time is known from document D10. Hence, the system of claim 19 differs from the one known from document D9 only in that the optical fibre is a single mode fibre. However, it is well-known in the given context that monomode fibres are suitable for this purpose (see document D11, col 2, second paragraph).

Hence, the system of claim 19 does not appear to involve an inventive step, either.

The dependent claims 20 - 22 would appear to introduce slight constructional changes of the known system. It is not clear that any of these claims, when taken in combination with claim 19, involves an inventive step.

8.1. Reference is made to the following document:

D12 = SHINICHI TAMURA ET AL.:
"Error correction in laser scanner three-dimensional measurement by two-axis model and coarse-fine parameter search"

PATTERN RECOGNITION, vol. 27 no. 3. March 1994, HEAD. HILL, OXFORD, GB.
pages 331 - 338

D13 = TAKEO KANADE ET AL.:
"A very fast VLSI rangefinder"
PROCEEDING OF THE 1991 IEEE INTERNATIONAL CONFERENCE ON ROBOTICS AND AUTOMATION, April 1991, SACRAMENTO, CA, US,
pages 1322 - 1329

8.2. The apparatus of **claims 23 - 27** differ from the one known from document D1 or D2 in the specific accuracies which are mentioned in the claims. However, these accuracies are within the normal ones achievable by known systems, see for instance document D12, the table on page 335. Under sample point 10, one can see that the accuracy is below 6 millimetres in a range below one hundred metres.

The features introduced in the dependent claims 24 - 26 are either values which are known for instance from document D8 or D13 (claim 24). Insofar as particularly "good values" (low power) are concerned, the claims do not give the technical features which allow the desired performance, but simply state the desired result. Hence, these claims define the claimed apparatus in terms of the desired result. However, merely formulating a desired result ("wishful thinking") does not involve an inventive step, at least as long as the technical features which make sure that the desired result is achieved are not clearly specified in the claim. Claim 27 adds a customary feature.

9.1. The features of **claim 34** are essentially the ones of claim 1. The further feature of manual adjustability of the laser beam is well-known in the art of rangefinders (see for instance document D9). Therefore, the apparatus of claim 34 does not involve an inventive step, either.

INVITATION TO RESTRICT OR TO PAY ADDITIONAL FEES International application No. PCT/US97/06793

From the above preliminary analysis of the claims it follows that a great number of different inventions have been collected in this international application. Some of these inventions may be novel, others are not; and most of them do not appear to involve an inventive step.

The inventions which are not novel, by definition, do not make a contribution over the prior art. As can be seen from the above analysis, the contributions which the novel invention make over the prior art are completely different and unrelated, so that no "special technical features" in the sense of Rule 13.2 PCT can be determined.

Clearly, a complete and detailed analysis of each feature of each claim of these unrelated inventions does require a large number of examinations (corresponding to the number of inventions). For this reason, the International Preliminary Examining Authority invites the applicant, at his option, to restrict the claims or to pay additional fees.

Accordingly, the International Preliminary Examining Authority takes the view that the present international application comprises eight different inventions or groups of inventions. Insofar, the International Preliminary Examining Authority follows the finding of the International Searching Authority. Concerning the number of inventions, the International Preliminary Examining Authority also follows the finding of the International Searching Authority.

If the applicant opts to restrict the claims, it would appear that a restriction to claims 35 and 36 would be in compliance with the applicable requirement. However, the main invention would appear to be the one of claims 1 - 3.

EXPRESS MAIL LABEL NO.
EM461821941US
Atty Docket No. KYRA-410 US4

PATENT COOPERATION TREATY

RECEIVED

SEP 2 4 1997

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

Limbach & Limbach

INVITATION TO PAY ADDITIONAL FEES

(PCT Article 17(3)(a) and Rule 40.1)

To:
LIMBACH & LIMBACH L.L.P.
Attn. STALLMAN, Michael A.
2001 Ferry Building
SAN FRANCISCO, CALIFORNIA 94111-4262
UNITED STATES OF AMERICA

Date of mailing *(day/month/year)*	19/09/1997
Applicant's or agent's file reference: KYRA-410 PCT	**PAYMENT DUE** within 45 ~~MAXIMUM~~/days from the above date of mailing
International application No.: PCT/US 97/06793	International filing date *(day/month/year)* 24/04/1997
Applicant: CYRA TECHNOLOGIES, INC. et al.	Due 11/3/97

1. This International Searching Authority

(i) considers that there are 8 *(number of)* inventions claimed in the international application covered by the claims indicated ~~below~~ on the extra sheet:

and it considers that **the international application does not comply with the requirements of unity of invention** (Rules 13.1, 13.2 and 13.3) for the reasons indicated ~~below~~ on the extra sheet:

(ii) [X] has carried out a partial international search (see Annex) [ ] will establish the international search report on those parts of the international application which relate to the invention first mentioned in claims Nos.:
1-3

(iii) will establish the international search report on the other parts of the international application only if, and to the extent to which, additional fees are paid

2. The applicant is hereby **invited**, within the time limit indicated above, to pay the amount indicated below:

DEM 2200.- (Fee per additional invention) x 7 (number of additional inventions) = DEM 15400.- (US$8,587.) (total amount of additional fees)

The applicant is informed that, according to Rule 40.2(c), **the payment of any additional fee may be made under protest,** i.e., a reasoned statement to the effect that the international application complies with the requirement of unity of invention or that the amount of the required additional fee is excessive.

3. [ ] Claim(s) Nos. _____ have been found to be unsearchable under Article 17(2)(b) because of defects under Article 17(2)(a) and therefore have not been included with any invention.

Name and mailing address of the International Searching Authority	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Falk Heck

Form PCT/ISA/206 (July 1992)

INVITATION TO PAY ADDITIONAL FEES

International application No.
PCT/US 97/06793

The International Searching Authority considers that the present application contains 8 inventions. This observation is based on the following reasons:

The prior art has been identified as: Optical Engineering 32, 9, September 1993, pp.2191-2200, C.BRADLEY et al.:"Free-form surface reconstruction for machine vision rapid prototyping".

1. From the comparison it appears that there are no Special Technical Features (Rule 13(1)) in independent claim 1 (claims 1-3) making a contribution over this prior art.

   There does therefore not appear to be any objective problem to be solved by this first invention.

2. From the comparison of claim 4 the following features can be seen to make a contribution over this same prior art:
   -method for controlling the timing of pulses in a scanning laser.

   From this the objective problem to be solved can be seen in the variability of the delay between turning on the pump diode and the firing of the laser.

3. From the comparison of claim 5 the following features can be seen to make a contribution over this same prior art:
   -method of manually separating subsets of the point data cloud.

   From this the objective problem to be solved can be seen in the identification of features in a scene.

4. From the comparison of claims 6-17 the following features can be seen to make a contribution over this same prior art:
   - method for segmentation and fitting of geometric primitives to the data points.

   From this the objective problem to be solved can be seen in the difficulty of recognizing shapes in a data point cloud.

5. From the comparison of claim 18 the following features can be seen to make a contribution over this same prior art:
   -laser light pulses lasting less than 1 nanosecond with up to 0.2 μJ in each pulse.

   From this the objective problem to be solved can be seen in the danger of eye damage caused by laser light.

6. From the comparison of claims 19-22, 35, 36 the following features can be seen to make a contribution over this same prior art:
-a single mode optical fiber of known length, a detector and a calculating processor.

From this the objective problem can be seen in the drift with temperature and time of the ranging electronics.

7. From the comparison of claims 23-27 the following features can be seen to make a contribution over this same prior art:
-monitor system having specified accuracies.

From this the objective problem can be seen in the necessary resolution of the data point cloud.

8. From the comparison of claims 28-34 the following features can be seen to make a contribution over this same prior art:
-video module for capturing image information from the object.

From this the objective problem to be solved can be seen in the difficulty of targeting aspects of the object to be scanned.

The above analysis shows that the Special Technical Features of invention 1 (claims 1-3) are not the same as or similar to those of the other 7 inventions.

A comparison of the objective problems, all seen in the light of the description and the drawings of the present application, indicates that there is no technical correspondence between these problems nor do they show any corresponding technical effect, so that the Special Technical Features of inventions 2-7 (claims 4-36) fail to demonstrate a correspondence with the Special Technical Features of invention 1 (claims 1-3) as required by Rule 13, (1) and (2) PCT.

Annex to n PCT/ISA/206
COMMUNICATION RELATING TO THE RESULTS OF THE PARTIAL INTERNATIONAL SEARCH

Inter. al Application No
PCT/US 97/06793

1. The present communication is an Annex to the invitation to pay additional fees (Form PCT/ISA/206). It shows the results of the international search established on the parts of the international application which relate to the invention first mentioned in claims Nos.:
1-3
2. This communication is not the international search report which will be established according to Article 18 and Rule 43.

3. If the applicant does not pay any additional search fees, the information appearing in this communication will be considered as the result of the international search and will be included as such in the international search report.

4. If the applicant pays additional fees, the international search report will contain both the information appearing in this communication and the results of the international search on other parts of the international application for which such fees will have been paid.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	BRADLEY C ET AL: "FREE-FORM SURFACE RECONSTRUCTION FOR MACHINE VISION RAPID PROTOTYPING" OPTICAL ENGINEERING, vol. 32, no. 9, 1 September 1993, pages 2191-2200, XP000396836 see the whole document	1-3

☐ Further documents are listed in the continuation of box C.

☐ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

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Staat Country Pays	Bankkonten Bank accounts Comptes bancaires	Postscheckkonten Giro accounts Comptes de chèques postaux	Zahlungswährung* Currency for payment* Monnaies de paiement*
AT	N° 102-133-851/00 (BLZ 12 000) Bank Austria AG Am Hof 2 A-1010 Wien	N° 7451.030 Österreichische Postsparkasse Georg Coch-Platz 2 A-1018 Wien	Österr. Schilling (ATS)
BE	N° 310-0449878-78 Banque Bruxelles Lambert BP 948 BRU. 5. B-1050 Bruxelles	N° 000-1154426-29 Office des Chèques postaux B-1100 Bruxelles	Franc belge (BEF)
CH	N° 322 005 01 B Schweizerische Bankgesellschaft CH-8021 Zürich	N° 30-30796-1 Zahlungsverkehr PTT Verarbeitungszentrum CH-4040 Basel	Franc suisse (CHF)
DE	N° 3 338 800 00 (BLZ 700 800 00) Dresdner Bank Promenadeplatz 7 D-80273 München	N° 300-800 (BLZ 700 100 80) Postbank München D-80138 München	Deutsche Mark (DEM)
DK	N° 3015-13375-9 Den Danske Bank Laksegade 8 DK-1092 Kobenhaven K.	N° 8995893 Girobank A/S Girostrøget 1 DK-0800 Høje Taastrup	Danske kroner (DKK)
ES	N° 0104-0328-95-0303480024 Banco Exterior de España Carrera de San Jeronimo 36 E-28014 Madrid	N° 18 716 786 Caja Postal Cuentas Extranjeras P° de Recoletos, 5 E-28070 Madrid	Peseta española (ESP)
FI	N° 200118-182076 Merita Bank Senaatintori SF-00020 Merita	N° 800013-90405 Postipankki Fabianinkatu 23 SF-00007 Helsinki	Suomen Markka (FIM)
FR	N° 000 200 20463 Code banque 30 004 Code guichet 00 567 Clé Rib 29 Banque Nationale de Paris Agence France-Etranger 2 Place de l'Opéra F-75002 Paris		Franc français (FRF)
FR	N° 0340581.981 J. Code banque 30 998 Code guichet 00 403 Clé Rib 72 Banque Worms 1, place de Degrés (Le Voltaire) F-92059 Paris la Défense		Franc français (FRF)
GB	N° 60271489 (Sorting Code 20-00-00) Barclays Bank PLC 54 Lombard Street P.O. Box 544 GB-London EC3V 9EX		Pound Sterling (GBP)
GR	N° 112002002007046 Credit Bank AE Athens Tower Branch 2, Messoghion Avenue GR-115 27 Athens		Greek Drachma (GRD)
IE	N° 309 822 01 (Bank Code 901 490) Bank of Ireland Lower Baggot Street Branch P.O. Box 3131 IRL-Dublin 2		Irish pound (IEP)
IT	N° 936832 01 94 ABI 02002 / CAB 03200 Banca Commerciale Italiana Via del Plebiscito 112 I-00186 Roma	N° 10568277 Centro Compartimentale Servizi Bancoposta per la Lombardia Piazza Vesuvio 6 I-20144 Milano	Lira italiana (ITL)
LU	N° 7-108/9134/200 Banque Internationale à Luxembourg 69 route d'Esch L-2953 Luxembourg	N° 26421-37 Administration des P. & T. Chèques postaux BP 2500 L-1090 Luxembourg	Franc belge (BEF)
MC	N° 000 254 22154 Code banque 30 004 Code guichet 09179 Clé Rib 91 Banque Nationale de Paris Succursale de Monte-Carlo Galerie Charles III Boîte Postale 129 MC-95007 Monaco Cédex		Franc français (FRF)
NL	N° 51 36 38 547 ABN-AMRO Bank NV Kneuterdijk 1, Postbus 165 NL-2501 AP Den Haag	N° 40 12 627 Postbank N.V. NL-6800 MA Arnhem	Nederlandse Gulden (NLG)
PT	N° 020-08-839 11 45 Banco Pinto et Sotto Mayor Av. Fontes Pereira de Melo, 7 P-1000 Lisboa		Escudo português (PTE)
SE	N° 122 687 108 Bankgiro N° 5843-6155 Svenska Handelsbanken S-106 70 Stockholm	N° 7 41 53-8 Postgirot S-105 06 Stockholm	Svenska kronor (SEK)

* 1 Die Zahlungswährung richtet sich nach der Währung des Staats, in dem das Konto geführt wird (Artikel 6 Absatz 1 Gebührenordnung).

2 Die Beträge der Gebühren, Auslagen und Verkaufspreise in der gemäß Ziffer 1 maßgebenden Währung ergeben sich aus dem Verzeichnis der Gebühren, Auslagen und Verkaufspreise des EPA (Beilage zum ABl. EPA 5/1997)

3 Bei allen Zahlungen muß daher sichergestellt werden, daß der Betrag auf dem Konto in der richtigen Währung (s. Ziffer 1) und in der richtigen Höhe (s. Ziffer 2) eingeht

* 1 Payments must be made in the currency of the state in which the EPO account in question is held (Article 6(1) Rules relating to Fees).

2 The Schedule of fees, costs and prices (Supplement to OJ EPO 5/1997) shows the various amounts payable in each currency.

3 When making payments, check that the correct amount (see the above-mentioned Schedule) in the correct currency (see point 1) is paid into the account

* 1 Le monnaie de paiement est celle du pays dans lequel le compte est ouvert (article 6, paragraphe 1 du règlement relatif aux taxes)

2 Les montants des taxes, frais et prix de vente dans la monnaie à utiliser selon le point 1 figurent dans le barème des taxes, frais et tarifs de vente de l'OEB (Supplément au JO OEB n° 5/1997)

3 Il convient donc de s'assurer, lors de chaque paiement, que ce compte est crédité du montant exact (voir point 2) dans la monnaie voulue (voir point 1)

EXPRESS MAIL LABEL NO. EM461821941US
Attorney Docket No. KYRA-410 US4 PCT/US97/06793

PATENT COOPERATION TREATY

PCT

From the INTERNATIONAL BUREAU

To:

STALLMAN, Michael, A.
Limbach & Limbach L.L.P.
2001 Ferry Building
San Francisco, CA 94111-4262
ETATS-UNIS D'AMERIQUE

NOTIFICATION OF RECEIPT OF RECORD COPY

(PCT Rule 24.2(a))

Date of mailing (day/month/year)	IMPORTANT NOTIFICATION
14 July 1997 (14.07.97)	
Applicant's or agent's file reference	**International application No.**
KYRA-410 PCT	PCT/US97/06793

The applicant is hereby notified that the International Bureau has received the record copy of the international application as detailed below.

Name(s) of the applicant(s) and State(s) for which they are applicants:

CYRA TECHNOLOGIES, INC. (for all designated States except US)
KACYRA, Ben, K. et al (for US)

International filing date	:	24 April 1997 (24.04.97)
Priority date(s) claimed	:	24 April 1996 (24.04.96)
Date of receipt of the record copy by the International Bureau	:	11 July 1997 (11.07.97)
List of designated Offices	:	

EP :AT,BE,CH,DE,DK,ES,FI,FR,GB,GR,IE,IT,LU,MC,NL,PT,SE
National :CA,JP,US

ATTENTION

The applicant should carefully check the data appearing in this Notification. In case of any discrepancy between these data and the indications in the international application, the applicant should immediately inform the International Bureau.

In addition, the applicant's attention is drawn to the information contained in the Annex, relating to:

- [X] time limits for entry into the national phase;
- [X] confirmation of precautionary designations;
- [ ] requirements regarding priority documents.

A copy of this Notification is being sent to the receiving Office and to the International Searching Authority.

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer: Marie-José Devillard
Facsimile No. (41-22) 740.14.35	Telephone No. (41-22) 338.83.38

Form PCT/IB/301 (September 1996) 001592940

INFORMATION ON TIME LIMITS FOR ENTERING THE NATIONAL PHASE

The applicant is reminded that the "national phase" must be entered before each of the designated Offices indicated in the Notification of Receipt of Record Copy (Form PCT/IB/301) by paying national fees and furnishing translations, as prescribed by the applicable national laws.

The time limit for performing these procedural acts is **20 MONTHS** from the priority date or, for those designated States which the applicant elects in a demand for international preliminary examination or in a later election, **30 MONTHS** from the priority date, provided that the election is made before the expiry of 19 months from the priority date. Some designated (or elected) Offices have fixed time limits which expire even later than 20 or 30 months from the priority date. In other Offices an extension of time or grace period, in some cases upon payment of an additional fee, is available.

In addition to these procedural acts, the applicant may also have to comply with other special requirements applicable in certain Offices. **It is the applicant's responsibility** to ensure that the necessary steps to enter the national phase are taken in a timely fashion. Most designated Offices do not issue reminders to applicants in connection with the entry into the national phase.

For detailed information about the procedural acts to be performed to enter the national phase before each designated Office, the applicable time limits and possible extensions of time or grace periods, and any other requirements, see the relevant Chapters of Volume II of the PCT Applicant's Guide. Information about the requirements for filing a demand for international preliminary examination is set out in Chapter IX of Volume I of the PCT Applicant's Guide.

Note that since ES is not bound by PCT Chapter II (which provides for the international preliminary examination procedure), that State cannot be elected in a demand for international preliminary examination. In the case of the designation of ES for a national patent, the applicant must thus always enter the national phase before the national Office of that State before the expiration of 20 months from the priority date. In the case of the designation of ES for a European patent, however, the 31-month time limit applies in respect of that designation if at least one other State designated for a European patent is also elected within the 19-month period.*

Note also that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

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* CH and LI became bound by PCT Chapter II on 1 September 1995. GR became bound by PCT Chapter II on 7 September 1996. Therefore, CH and LI may be elected in a demand or a later election filed on or after 1 September 1995, and GR may be elected in a demand or a later election filed on or after 7 September 1996, regardless of the filing date of the international application. (See 2nd paragraph above.)

CONFIRMATION OF PRECAUTIONARY DESIGNATIONS

This notification lists only specific designations made under Rule 4.9(a) in the request. It is important to check that these designations are correct. Errors in designations can be corrected where precautionary designations have been made under Rule 4.9(b). The applicant is hereby reminded that any precautionary designations may be confirmed according to Rule 4.9(c) before the expiration of 15 months from the priority date. If it is not confirmed, it will automatically be regarded as withdrawn by the applicant. There will be no reminder and no invitation. Confirmation of a designation consists of the filing of a notice specifying the designated State concerned (with an indication of the kind of protection or treatment desired) and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.

REQUIREMENTS REGARDING PRIORITY DOCUMENTS

For applicants who have not yet complied with the requirements regarding priority documents the following is recalled.

Where the priority of an earlier national (i.e., national or regional) application is claimed, the applicant must submit a copy of the said national application, certified by the authority with which it was filed ("the priority document") to the receiving Office (which will transmit it to the International Bureau) or directly to the International Bureau, before the expiration of 16 months from the priority date (Rule 17.1).

Where the priority document is issued by the receiving Office, the applicant may, instead of submitting the priority document, request the receiving Office to prepare and transmit the priority document to the International Bureau. Such a request must be made before the expiration of the 16-month time limit.

It is recalled that, where several priorities are claimed, the priority date to be considered for the purposes of computing the 16-month time limit is the filing date of the earliest application whose priority is claimed.

If the priority document concerned is not submitted to the International Bureau before the expiration of the 16-month time limit, or if the request to the receiving Office to transmit the priority document has not been made (and the corresponding fee, if any, paid) before the expiration of this time limit, any designated State may disregard the priority claim.

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

To:

STALLMAN, Michael, A.
~~Limbach & Limbach L.L.P.~~
2001 Ferry Building
San Francisco, CA 94111-4262
ETATS-UNIS D'AMERIQUE

NOTIFICATION CONCERNING SUBMISSION OF PRIORITY DOCUMENTS

(PCT Administrative Instructions, Section 411)

Date of mailing (day/month/year)
17 July 1997 (17.07.97)

Applicant's or agent's file reference
KYRA-410 PCT

IMPORTANT NOTIFICATION

International application No.	**International filing date** (day/month/year)	**Priority date** (day/month/year)
PCT/US97/06793	24 April 1997 (24.04.97)	24 April 1996 (24.04.96)

Applicant
CYRA TECHNOLOGIES, INC. et al

The applicant is hereby notified of the date of receipt by the International Bureau of the priority document(s) relating to the following application(s):

Priority application No:	Priority date:	Priority country:	Date of receipt of priority document:
08/638,961	24 Apr 1996 (24.04.96)	US	17 Jul 1997 (17.07.97)

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer
P. Asseeff

Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

OCT 14 1998

LIMBACH & LIMBACH

STALLMAN, Michael, A.
Limbach & Limbach L.L.P.
2001 Ferry Building
San Francisco, CA 94111-4262
ETATS-UNIS D'AMERIQUE

Date of mailing (day/month/year) 28 September 1998 (28.09.98)	
Applicant's or agent's file reference KYRA-410 PCT	**IMPORTANT NOTIFICATION**
International application No. PCT/US97/06793	**International filing date** (day/month/year) 24 April 1997 (24.04.97)

1. The following indications appeared on record concerning:

[X] the applicant [ ] the inventor [ ] the agent [ ] the common representative

Name and Address	State of Nationality	State of Residence
CYRA TECHNOLOGIES, INC. Suite 320 25 Orinda Way Orinda, CA 94563 United States of America	US	US
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [ ] the name [X] the address [ ] the nationality [ ] the residence

Name and Address	State of Nationality	State of Residence
CYRA TECHNOLOGIES, INC. 8000 Capwell Drive Oakland, CA 94621 United States of America	US	US
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[ ] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bur au f WIPO 34, chemin des Col mbettes 1211 G neva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Marie-José Devillard Telephone No.: (41-22) 338.83.38

Form PCT/IB/306 (March 1994)

002253186

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:

RBH

STALLMAN, Michael, A.
Limbach & Limbach L.L.P.
2001 Ferry Building
San Francisco, CA 94111-4262
ETATS-UNIS D'AMERIQUE

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Date of mailing (day/month/year) 30 October 1997 (30.10.97)	
Applicant's or agent's file reference KYRA-410 PCT	**IMPORTANT NOTICE**

International application No.	**International filing date** (day/month/year)	**Priority date** (day/month/year)
PCT/US97/06793	24 April 1997 (24.04.97)	24 April 1996 (24.04.96)

Applicant
CYRA TECHNOLOGIES, INC. et al

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
   CA,EP,JP,US

   In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
   None

   The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
   30 October 1997 (30.10.97) under No. WO 97/40342

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2) 10/24/98 ncal

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, **a demand for international preliminary examination** must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the **national phase**, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limit and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer J. Zahra
Facsimile No. (41-22) 740.14.35	Telephone No. (41-22) 338.83.38

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

INFORMATION CONCERNING ELECTED OFFICES NOTIFIED OF THEIR ELECTION

(PCT Rule 61.3)

To:

DEC 0 1 1997

STALLMAN, Michael, A.
Limbach & Limbach L.L.P.
2001 Ferry Building
San Francisco, CA 94111-4262
ETATS-UNIS D'AMERIQUE

Date of mailing (day/month/year) 25 November 1997 (25.11.97)	
Applicant's or agent's file reference KYRA-410 PCT	**IMPORTANT INFORMATION**

International application No.	**International filing date** (day/month/year)	**Priority date** (day/month/year)
PCT/US97/06793	24 April 1997 (24.04.97)	24 April 1996 (24.04.96)

Applicant
CYRA TECHNOLOGIES, INC. et al

1. The applicant is hereby informed that the International Bureau has, according to Article 31(7), notified each of the following Offices of its election:

   EP :AT,BE,CH,DE,DK,ES,FI,FR,GB,GR,IE,IT,LU,MC,NL,PT,SE
   National :CA,JP,US

2. The following Offices have waived the requirement for the notification of their election; the notification will be sent to them by the International Bureau only upon their request:

   None

   10/24/98 original

3. The applicant is reminded that he must enter the "national phase" **before the expiration of 30 months from the priority date** before each of the Offices listed above. This must be done by paying the national fee(s) and furnishing, if prescribed, a translation of the international application (Article 39(1)(a)), as well as, where applicable, by furnishing a translation of any annexes of the international preliminary examination report (Article 36(3)(b) and Rule 74.1).

   Some offices have fixed time limits expiring later than the above-mentioned time limit. For detailed information about the applicable time limits and the acts to be performed upon entry into the national phase before a particular Office, see Volume II of the PCT Applicant's Guide.

   The entry into the European regional phase is postponed **until 31 months from the priority date** for all States designated for the purposes of obtaining a European patent.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer:
J. Leitao

Telephone No. (41-22) 338.83.38

PATENT COOPERATION TREA

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Atty Docket No. KYRA-410 US4

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From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Rule 71.1)

To:

STALLMAN, Michael A.
LIMBACH & LIMBACH L.L.P.
2001 Ferry Building
SAN FRANCISCO,CALIFORNIA 94111-4262
ETATS-UNIS D'AMERIQUE

Date of mailing *(day/month/year)*	20.08.98
Applicant's or agent's file reference: KYRA-410 PCT	**IMPORTANT NOTIFICATION**

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US97/06793	24/04/1997	24/04/1996

Applicant
CYRA TECHNOLOGIES, INC. et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/	Authorized officer
European Patent Office D-80298 Munich Tel. (+49-89) 2399-0, Tx: 523656 epmu d Fax: (+49-89) 2399-4465	De Caevel, J-M Tel. (+49-89) 2399-2557

Form PCT/IPEA/416 (July 1992)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (PCT/IPEA/416)
KYRA-410 PCT		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US97/06793	24/04/1997	24/04/1996
International Patent Classification (IPC) or national classification and IPC		
G01C11/00		
Applicant		
CYRA TECHNOLOGIES, INC. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 14 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:

I	☒	Basis of the report
II	☐	Priority
III	☐	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
IV	☒	Lack of unity of invention
V	☒	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
VI	☐	Certain documents cited
VII	☒	Certain defects in the international application
VIII	☐	Certain observations on the international application

Date of submission of the demand	Date of completion of this report
10/11/1997	20.08.98
Name and mailing address of the IPEA/	Authorized officer
European Patent Office D-80298 Munich Tel. (+49-89) 2399-0, Tx: 523656 epmu d Fax: (+49-89) 2399-4465	Kunzelmann, C Telephone No. (+49-89) 2399-2834

Form PCT/IPEA/409 (Cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/US97/06793

I. Basis f th report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-122 as originally filed

Claims, No.:

1-3 as originally filed

Drawings, sheets:

1/44-44/44 as originally filed

2. The amendments have resulted in the cancellation of:

☐ the description, pages:

☒ the claims, Nos.: 4 - 36

☐ the drawings, sheets:

3. ☒ This report has been established as if (some of) the amendments had not been made, since they hav been considered to go beyond the disclosure as filed (Rule 70.2(c)):

see separate sheet

4. Additional observations, if necessary:

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

☒ restricted the claims.

☐ paid additional fees.

☐ paid additional fees under protest.

☐ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

   ☐ complied with.

   ☒ not complied with for the following reasons:

   see separate sheet

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

   ☐ all parts.

   ☒ the parts relating to claims Nos. 1 - 3.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	
	No:	Claims	1 - 3
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1 - 3
Industrial applicability (IA)	Yes:	Claims	1 - 3
	No:	Claims	

2. Citations and explanations

   see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

CONCERNING SECTION I:

1) The "new proposed claims" numbered 37 - 51 comprise an independent apparatus claim 37 and an independent method claim 43, with respective dependent claims 38 - 42 and 44 - 51. Both independent claims 37 and 43 are related to the invention originally mentioned in claims 1 - 3. However, the scope of the proposed claims is much narrower.

One feature restricting the scope of the independent claim 37 is that the processor is arranged to generate (i) an overall scan of the object, (ii) a scan of a selected region within the object, and (iii) that the modelling module functions to integrate the data points from these two scans into a composite image. Independent method claims 43 comprises corresponding method steps a), c) and d).

However, the international application as originally filed does not comprise the information of the **combination** of features (i), (ii) and (iii) for the following reasons.

The paragraph relating to "Scan Control" on pages 40 - 41 discloses that portions of the scene which is visible to the laser scanner can be indicated, for instance by indicating with a mouse on the video image the relevant portions. It is also possible to do additional scans with different densities. Hence, there is a disclosure of scanning a selected region within the object.
The paragraph relating to "Modelling" on pages 50 - 52, and in particular the one relating to "Merging" on page 51 also discloses that scans of different portions of a single object can be joined to forma a single object. This would appear to be the basis for the "integration of data points into a composite image".

There would not appear to be any better basis for the proposed independent claims than the paragraphs discussed above and their corresponding (less detailed) counterparts in the different integrated annexes (see pages 69 -122).

Hence, there is only a disclosure of merging different portions of a single object, but no disclosure of merging the scan of the whole object with a scan of a selected region of the object. Even though it is clear that the originally disclosed

integrated system can be operated in the manner specified in independent claims 37 and 43, said **particular selection of scans** for integration into a composite image has not been originally disclosed.

Therefore, the modified claims infringe Article 34(2)(b) PCT. Consequently, they are not taken into account in this international preliminary examination report (Rule 70.2 c) PCT, PCT-Guidelines PCT/GL/3, Chapter VI, 8.5).

2) Since the applicant has explicitly opted to restrict the claims to the invention of original claims 1 - 3, and the restricted claims relating to this invention may not be taken into account, this international preliminary examination report is based on original claims 1 - 3.

CONCERNING SECTION IV):

As will be set out below, this international application is at least eightfold non-unitary. The eight inventions are set out in original claims 1 - 3; 4; 5; 6 - 17; 18; 19 -22, 35, 36; 23 - 27; 28 - 34. The applicant has opted to restrict the claims to the invention of claims 1 - 3.

1.1. Reference is made to the following documents:

D1 = COLIN BRADLEY ET Al:
"FREE-FORM SURFACE RECONSTRUCTION FOR MACHINE VISION RAPID PROTOTYPING";
OPTICAL ENGINEERING, vol. 32, no. 9, 1 September 1993, pages 2191 - 2200.

D2 = GB-A-2 292 605

2) CLAIMS WITHOUT SPECIAL TECHNICAL FEATURES (Rule 13 PCT):

2.1. Document D1 is considered to represent the nearest prior art as far as **claims 1 - 3** are concerned. This document describes a system for prototyping, ie for

generating a model of a three-dimensional scene (see the paragraph "Introduction"). The prototyping system is a 3-D laser scanner system integrated with a CNC machining center and a programmable CMM (see the paragraph "Interfacing the Range Sensor with a Translation System"). The laser scanner produces a point cloud ("cloud data") of points, each point corresponding to a location on the surface of the scanned scene. In the paragraph "Reconstructing Free-Form Surfaces", various techniques for generating a three-dimensional model from the point cloud are described. The mathematical model is used to physically machine the surface a body so that the desired model is established (see the Section "Testing of the free-Form Surface Modelling Method").

Hence, document D1 shows an integrated system according to claim 1. Therefore, the claimed system is considered not novel (Article 33(2) PCT).

Furthermore, the input of the data file corresponding to the scanned model into a CAD system is also described in the Sections "Introduction" and "Testing of the free-Form Surface Modelling Method". Clearly, the CAD system must be started somehow, and the loading of the data file must be performed automatically (by the software governing the loading process). Hence, also the system of claims 2 and 3 is considered not novel.

For the sake of completeness, it is mentioned that document D2 is similarly relevant (see claim 1 in combination with page 4, line 6 - page 5, line 12 and page 8, line 34 - page 9, line 3). The relation with the CAD system is mentioned on page 22.

2.3. The apparatus of **claims 28 - 33** is considered not novel with respect to document D12 (see paragraph 8.1. below), since this document (see the paragraph 1. Introduction) mentions the combination of a laser beam scanning the object and of taking a TV camera image of the object for calibration purposes (see paragraph 4. calibration).

2.4. Hence, the non-novel inventions of these claims do not make a contribution over the prior art.

3) **CLAIMS WITHOUT CORRESPONDING SPECIAL TECHICAL FEATURES:**

3.1. Reference is made to the following documents:

D3 = US-A-4 658 218
D4 = JP-A-06 188 501 (English abstract)

3.2. Document D3 is considered to represent the nearest prior art as far as **claim 4** is concerned.
This document describes a laser system in which a dye laser's 16 output pulse is fed into an optical amplifier chain 18. The amplifier chain is pulsed by a Nd:YAG laser; the Nd:YAG pulse timing is determined by an active Q-switch.

It is common knowledge in the art of lasers that there are two fundamental possibilities for controlling the timing of laser output pulses. The first one is to bring the laser in a condition where it is ready for lasing, and then to use an active Q-switch to release the laser pulse at a predetermined time. The second one is to pump the laser until it reaches the lasing threshold, and allowing lasing as soon as the threshold is reached (no Q-switch or passive Q-switch). Documents D3 and D4 describe the first possibility.

Present claim 4 would appear to claim the second one of these two known fundamental possibilities.

Hence, the method of claim 4 is considered not to involve an inventive step (Article 33(3) PCT), because it results from the application of the second fundamental possibility mentioned above to the known problem of controlling the timing of laser pulses in scanning lasers.

4) Present **claim 5** would appear to cover any mouse-supported image processing software: It is well-known that image processing software allows to select regions of interest (ie to select all the data points representing a desired feature), starting from the complete data set, ie from all the available image points, including all the point sets which cover a desired feature. This is frequently done using a computer mouse by marking the borders of the regions of interest (ie drawing a polygonal

lasso). This step can be repeated as often as necessary and also for a plurality of views of the respective region.

Hence, it would appear that claim 5 is the obvious application of well-known image processing software to images in the form of clouds of points representing three-dimensional features in a scene. Thus, the method of claim 5 does not appear to involve an inventive step.

5.1. Reference is made to the following documents:

D5 = JONG HOON PARK ET AL.:
"Three-dimensional object representation and recognition based on surface normal images", PATTERN RECOGNITION, vol. 26, no. 6, June 1993, pages 913 - 921

D6 = PAUL A. HEMLER ET AL.:
"Active model matching in range images"
IEEE INTERNATIONAL CONFERENCE ON ROBOTICS AND AUTOMATION, vol. 1, 31 March 1987 - 3 April 1987, RALEIGH, NC US, pages 228 - 233

D7 = NARAYAN SRIRANGA RAJ ET AL.:
"Obtaining generic parts from range images using a multi-view representation"
IMAGE UNDERSTANDING, vol. 60, no 1. July 1994, ORLANDO, FL, US pages 44 - 64

5.2. **Claims 9 - 17** relate to different methods for fitting or modelling a point cloud to a three-dimensional object. There is extensive literature about these modelling problems (see documents D5 - D7). In particular, it would appear that the three-dimensional bodies mentioned in claims 9 - 13 (cube, sphere, cylinder) are among the normal part primitives which are on the basis of any object modelling or object matching (see document D9, section I. Introduction). Similarly, the fitting techniques mentioned in these claims appear to be usual ones.
The merging of two or more geometric primitives to form a single geometric primitive (claim 14) would appear to be known from the object-matching of complicated multi-part objects (see document D9, section 5. Obtaining parts-

based representation). The coordinates system transformation of claim 15 would appear to be known from document D5 (Section 1. Introduction).
Hence, the subject-matter of these claims does not appear to involve an inventive step.

6.1. Reference is made to the following document:

D8 = US-A-4 907 586

6.2. The system of **claim 18** differs from the known systems according to documents D1 or D2 in that a particular type of laser is used. However, this particular type of laser is known for instance from document D8 (see col. 4, line 46 - col. 5, line 20). Even though the particular intended use of the laser of document D8 is different from the one of documents D1 and D2, it would appear to be within the customary practice of the person skilled in the art to consider any known laser which would be an alternative to the ones of documents D1 or D2. In particular, it would appear that pulsed lasers could have advantages over cw lasers when using the laser beam for scanning a three-dimensional object for forming the respective point cloud, because disadvantages related to the movement of the laser beam across the object may be reduced.
Hence, it would appear that the person skilled in the art would have had good reasons to consider in particular the pulsed laser of document D8 for the use according to documents D1 or D2.
Thus, the system of claim 18 does not appear to involve an inventive step.

7.1. Reference is made to the following documents:

D9 = JP-A-62 108 172
D10 = JP-A-57 004 564
D11= DE-A-41 09 844

7.2. Document D9 is considered to represent the nearest prior art as far as **claims 19 - 22** are concerned. From this document, the calibration of laser range finders using an optical fibre of known length is known. The calibration takes place by sending a light pulse through an optical fibre of known length and coupling the

returning pulse into the detector of the laser range finder. The "offset error" mentioned in document D9 is an error which is relevant in the calibration of the measuring electronics. That the offset error is related to a delay time is known from document D10. Hence, the system of claim 19 differs from the one known from document D9 only in that the optical fibre is a single mode fibre. However, it is well-known in the given context that monomode fibres are suitable for this purpose (see document D11, col 2, second paragraph).

Hence, the system of claim 19 does not appear to involve an inventive step, either.

The dependent claims 20 - 22 would appear to introduce slight constructional changes of the known system. It is not clear that any of these claims, when taken in combination with claim 19, involves an inventive step.

8.1. Reference is made to the following document:

D12 = SHINICHI TAMURA ET AL.:
"Error correction in laser scanner three-dimensional measurement by two-axis model and coarse-fine parameter search"
PATTERN RECOGNITION, vol. 27 no. 3. March 1994, HEAD. HILL, OXFORD, GB.
pages 331 - 338

D13 = TAKEO KANADE ET AL.:
"A very fast VLSI rangefinder"
PROCEEDING OF THE 1991 IEEE INTERNATIONAL CONFERENCE ON ROBOTICS AND AUTOMATION, April 1991, SACRAMENTO, CA, US,
pages 1322 - 1329

8.2. The apparatus of **claims 23 - 27** differ from the one known from document D1 or D2 in the specific accuracies which are mentioned in the claims. However, these accuracies are within the normal ones achievable by known systems, see for instance document D12, the table on page 335. Under sample point 10, one can see that the accuracy is below 6 millimetres in a range below one hundred metres.

The features introduced in the dependent claims 24 - 26 are either values which are known for instance from document D8 or D13 (claim 24). Insofar as particularly "good values" (low power) are concerned, the claims do not give the technical features which allow the desired performance, but simply state the desired result. Hence, these claims define the claimed apparatus in terms of the desired result. However, merely formulating a desired result ("wishful thinking") does not involve an inventive step, at least as long as the technical features which make sure that the desired result is achieved are not clearly specified in the claim. Claim 27 adds a customary feature.

9.1. The features of **claim 34** are essentially the ones of claim 1. The further feature of manual adjustability of the laser beam is well-known in the art of rangefinders (see for instance document D9). Therefore, the apparatus of claim 34 does not involve an inventive step, either.

10) From the above analysis of the claims it follows that a great number of different inventions have been collected in this international application. Some of these inventions may be novel, others are not; and most of them do not appear to involve an inventive step.

The inventions which are not novel, by definition, do not make a contribution over the prior art. As can be seen from the above analysis, the contributions which the novel inventions make over the prior art are completely different and unrelated, so that no "corresponding special technical features" in the sense of Rule 13.2 PCT can be determined.

Accordingly, the International Preliminary Examining Authority takes the view that the present international application comprises eight different inventions or groups of inventions. Insofar, the International Preliminary Examining Authority follows the finding of the International Searching Authority. Concerning the number of inventions, the International Preliminary Examining Authority also follows the finding of the International Searching Authority.

CONCERNING SECTION V:

1) TECHNICAL FIELD:

This invention concerns an integrated laser scanning and modelling system for generating a model of a three-dimensional scene.

2) CLAIMS:

The invention under examination is defined in an independent claim 1, which is followed by dependent claims 2 and 3.

3) PRIOR ART (Rule 64.1 PCT):

3.1. Reference is made to the following documents:

D1 = COLIN BRADLEY ET Al:
"FREE-FORM SURFACE RECONSTRUCTION FOR MACHINE VISION RAPID PROTOTYPING";
OPTICAL ENGINEERING, vol. 32, no. 9, 1 September 1993, pages 2191 - 2200.

D2 = GB-A-2 292 605

4) NOVELTY (Article 33(2) PCT):

4.1. Document D1 is considered to represent the nearest prior art.
This document describes a system for prototyping, ie for generating a model of a three-dimensional scene (see the paragraph "Introduction"). The prototyping system is a 3-D laser scanner system integrated with a CNC machining center and a programmable CMM (see the paragraph "Interfacing the Range Sensor with a Translation System"). The laser scanner produces a point cloud ("cloud data") of

points, each point corresponding to a location on the surface of the scanned scene. In the paragraph "Reconstructing Free-Form Surfaces", various techniques for generating a three-dimensional model from the point cloud are described. The mathematical model is used to physically machine the surface a body so that the desired model is established (see the Section "Testing of the free-Form Surface Modelling Method").

Hence, document D1 shows an integrated system according to claim 1. Therefore, the claimed system does not appear to be not novel (Article 33(2) PCT).

Furthermore, the input of the data file corresponding to the scanned model into a CAD system is also described in the Sections "Introduction" and "Testing of the free-Form Surface Modelling Method". Clearly, the CAD system must be started somehow, and the loading of the data file must be performed automatically (by the software governing the loading process). Hence, the system of claims 2 and 3 is not novel, either.

For the sake of completeness, it is mentioned that document D2 is similarly relevant (see claim 1 in combination with page 4, line 6 - page 5, line 12 and page 8, line 34 - page 9, line 3). The relation with the CAD system is mentioned on page 22.

4.2. Hence, the system of claims 1, 2 and 3 does not appear to be novel (Article 33(2) PCT).

5.1. Since it is apparently not novel, the claimed system cannot involve an inventive step (Article 33(3) PCT). However, its industrial applicability (Article 33(4) PCT) is clear.

CONCERNING SECTION VII:

1) Independent claim 1 is not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (document D1) being placed in a preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in a characterising part (Rule 6.3(b)(ii) PCT).

2) The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

3) Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 and D2 is not mentioned in the description, nor are these documents identified therein.